

CENTRIFUGAL SHOT BLASTING

The Need

In July and August 1998, a demonstration was completed evaluating Centrifugal Shot Blasting (CSB). Centrifugal shot blasting is a surface scabbling method that can be used for removing concrete. The goal of the demonstration was to assess the ability of CSB to remove one inch of contaminated concrete in a controlled, dustless, safe, and efficient fashion. In addition to assessing the CSB, another method of concrete removal, using a rotary drum planer attached to a Bobcat was also evaluated.

At Fernald and throughout the DOE complex there are large areas of radioactively and chemically contaminated concrete that represent costly, time-consuming, and potentially hazardous removal problems for D&D managers. Most of the contamination resides in the upper one inch of concrete. The motivation for removing only the surface of the concrete lies in reducing disposal costs, while attaining essentially 100% removal of contaminants. In designated areas at Fernald, regulators have agreed that if the top one inch of concrete is removed and sent off-site for disposal, the rest of the concrete can be broken up and sent to the On Site Disposal Facility (OSDF), resulting in significant cost and schedule saving. Past methods of concrete removal have included jack-hammering, diamond wire sawing, and scabbling using pneumatically driven piston heads. Each of these methods has drawbacks, such as extremely slow production rates, large crew requirements, and/or the generation of airborne contamination.



Figure 12. Centrifugal Shot Blasting, Concrete Cleaning Inc.

The Technology

The CSB machine demonstrated at Fernald works by propelling hardened steel shot at high velocities (~220 ft/sec.) onto concrete floor surfaces. The impact of the shot causes the concrete to fracture into small pieces. The pieces are then captured by an integrated vacuum dust collection system. The majority of the steel shot rebounds back up into the machine where it is reused. Shot that is left on the floor is picked up by a large portable magnet and recycled back into the machine. The shot is continually reused until it is essentially reduced to the size of dust and is conveyed off in the dust collection system. The centrifugal shot blasting machine cuts a 20" swath, approximately 1/8" to 3/8"-deep per pass, depending on the hardness of the concrete and speed at which the CSB travels over the area being scabbled.

The rotary drum planer contains a drum that is embedded with 62 replaceable tungsten-carbide teeth. The planer cuts a 16" wide swath up to 6" deep providing there is not wire or re-bar present in the concrete. The rotary drum planer technology has been widely used for the removal of concrete in highways and parking lots by the construction industry for many years. For use at Fernald, the rotary drum planer system was modified so that it would offer a dustless process with the capability for simultaneous drumming of waste by utilizing a VecLoader HEPA-Vac attached to a custom fabricated vacuum shroud for the planer (for more information on the VecLoader, please read the ITSR for the VecLoader).

The Demonstration

The CSB demonstration was conducted in the muffle furnace area (Process Area 4) of Fernald's Plant 8, over an area of 1464 ft². The muffle furnace area of Plant 8 was chosen due to its contamination with Technetium-99 and the regulatory requirement that one inch of concrete must be removed from this area and sent off-site for disposal. The rotary drum planer was demonstrated in Plant 9 over an area of 21,000 ft² by the Plant 9 D&D subcontractor. Plant 9 was scabbled for the same reasons as Plant 8. Specific parameters such as production rates (ft²/hr @ 1" depth), quantity of waste per ft² of concrete scabbled, crew sizes and other project specific costs for each technology were recorded to accurately measure and compare the performance of the two technologies.

Results

While the CSB technology easily removed the first 1/8" to 3/16" of concrete, the technology had considerable difficulty in removing the remaining concrete down to 1" total depth. The difficulty can be attributed mainly to the large (up to 2" diameter) natural riverine pebbles in the concrete. The large riverine pebbles caused the rebound/recycle mechanism of the CSB to be less effective, requiring more work to pick up the shot and refill the machine. The riverine pebbles were also harder than the concrete, leading to slower than expected production rates. Despite these obstacles, the CSB was a good choice for an area of this size, due to its good maneuverability.

The rotary drum planer proved to be a robust and viable technology for heavy concrete removal over the large and open areas in Fernald's Plant 9. The drum system was less expensive to operate and operated for longer periods of time than the CSB technology, without breakdown. The major delays associated with the rotary drum planer can be attributed to its vulnerability to reinforcing steel bars and wire mesh that was in close proximity to the surface, which resulted in broken teeth and entwined mesh on the drum.

For concrete removal at depths equal to or greater than 3/16", in relatively large open areas, the rotary drum planer is the recommended technology. For concrete removal at depths between 1/8" and 3/16" and in confined areas, even at 1" depth, the CSB is the recommended technology because it has greater maneuverability and generates less waste per unit area.